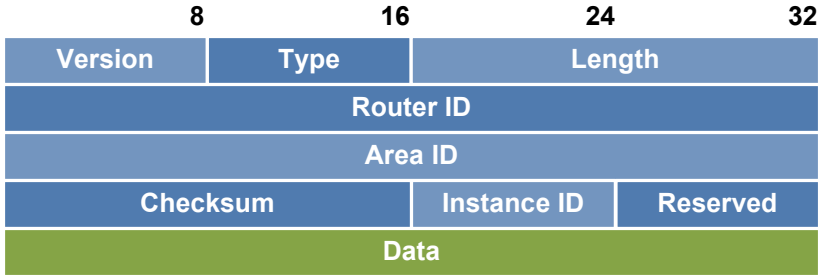
OSPF · Part 1

Protocol Header



Link State Advertisements

Router Link (Type 1)
Lists neighboring routers and the cost to each; flooded within an area

Network Link (Type 2)
Generated by a DR; lists all routers on an adjacent segment; flooded within an area

Network Summary (Type 3)
Generated by an ABR and advertised among areas

ASBR Summary (Type 4)
Injected by an ABR into the backbone to advertise the presence of an ASBR within an area

External Link (Type 5)
Generated by an ASBR and flooded throughout the AS to advertise a route external to OSPF

NSSA External Link (Type 7)
Generated by an ASBR in a not-so-stubby area; converted into a type 5 LSA by the ABR when leaving the area

Router Types

Internal Router
All interfaces reside within the same area

Backbone Router
A router with an interface in area 0 (the backbone)

Area Border Router (ABR)
Connects two or more areas

AS Boundary Router (ASBR)
Connects to additional routing domains; typically located in the backbone

Area Types

Standard Area
Default OSPF area type

Stub Area
External link (type 5) LSAs are replaced with a default route

Totally Stubby Area
Type 3, 4, and 5 LSAs are replaced with a default route

Not So Stubby Area (NSSA)
A stub area containing an ASBR; type 5 LSAs are converted to type 7 within the area

External Route Types

E1 · Cost to the advertising ASBR plus the external cost of the route

E2 (Default) · Cost of the route as seen by the ASBR

Troubleshooting

`show ip [route | protocols]`	`show ip ospf border-routers`
`show ip ospf interface`	`show ip ospf virtual-links`
`show ip ospf neighbor`	`debug ip ospf […]`

Attributes

Type	Link-State
Algorithm	Dijkstra
Metric	Cost (Bandwidth)
AD	110
Standard	RFC 2328, 2740
Protocols	IP
Transport	IP/89
Authentication	Plaintext, MD5
AllSPF Address	224.0.0.5
AllDR Address	224.0.0.6

Metric Formula

$$\text{cost} = \frac{100{,}000\ \text{Kbps}^*}{\textbf{link speed}}$$

* modifiable with
`ospf auto-cost reference-bandwidth`

Adjacency States

1 Down	**5** Exstart
2 Attempt	**6** Exchange
3 Init	**7** Loading
4 2-Way	**8** Full

DR/BDR Election

· The DR serves as a common point for all adjacencies on a multiaccess segment

· The BDR also maintains adjacencies with all routers in case the DR fails

· Election does not occur on point-to-point or multipoint links

· Default priority (0-255) is 1; highest priority wins; 0 cannot be elected

· DR preemption will not occur unless the current DR is reset

Virtual Links

· Tunnel formed to join two areas across an intermediate

· Both end routers must share a common area

· At least one end must reside in area 0

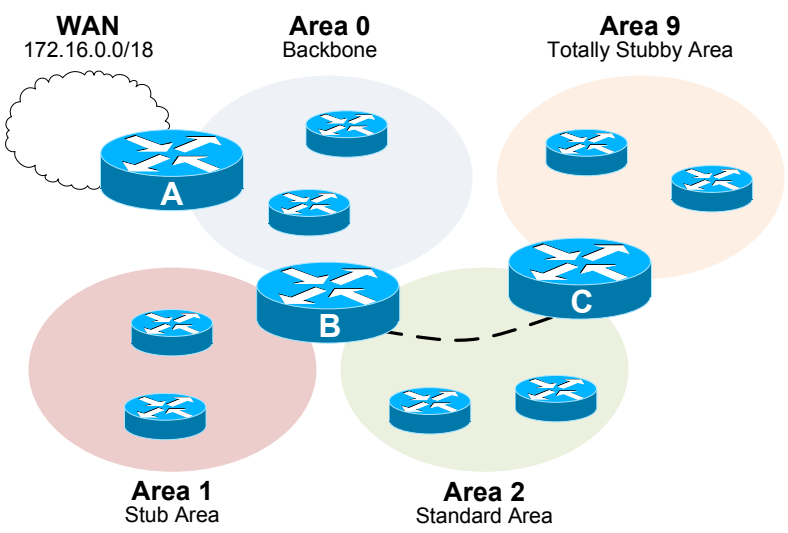
· Cannot traverse stub areas

OSPF · Part 2

Network Types

	Nonbroadcast (NBMA)	Multipoint Broadcast	Multipoint Nonbroadcast	Broadcast	Point-to-Point
DR/BDR Elected	Yes	No	No	Yes	No
Neighbor Discovery	No	Yes	No	Yes	Yes
Hello/Dead Timers	30/120	30/120	30/120	10/40	10/40
Defined By	RFC 2328	RFC 2328	Cisco	Cisco	Cisco
Supported Topology	Full Mesh	Any	Any	Full Mesh	Point-to-Point

Configuration Example



Router A

```
interface Serial0/0
 description WAN Link
 ip address 172.16.34.2 255.255.255.252
!
interface FastEthernet0/0
 description Area 0
 ip address 192.168.0.1 255.255.255.0
!
interface Loopback0
! Used as router ID
 ip address 10.0.34.1 255.255.255.0
!
router ospf 100
 ! Advertising the WAN cloud to OSPF
 redistribute static subnets
 network 192.168.0.0 0.0.0.255 area 0
!
! Static route to the WAN cloud
ip route 172.16.0.0 255.255.192.0 172.16.34.1
```

Router B

```
interface Ethernet0/0
 description Area 0
 ip address 192.168.0.2 255.255.255.0
 ip ospf 100 area 0
!
interface Ethernet0/1
 description Area 2
 ip address 192.168.2.1 255.255.255.0
 ip ospf 100 area 2
 ! Optional MD5 authentication configured
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 FooBar
 ! Give B priority in DR election
 ip ospf priority 100
!
interface Ethernet0/2
 description Area 1
 ip address 192.168.1.1 255.255.255.0
 ip ospf 100 area 1
!
interface Loopback0
 ip address 10.0.34.2 255.255.255.0
!
router ospf 100
 ! Define area 1 as a stub area
 area 1 stub
 ! Virtual link from area 0 to area 9
 area 2 virtual-link 10.0.34.3
```

Router C

```
interface Ethernet0/0
 description Area 9
 ip address 192.168.9.1 255.255.255.0
 ip ospf 100 area 9
!
interface Ethernet0/1
 description Area 2
 ip address 192.168.2.2 255.255.255.0
 ip ospf 100 area 2
 ! Optional MD5 authentication configured
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 FooBar
 ! Give C second priority (BDR) in election
 ip ospf priority 50
!
!
!
!
!
!
interface Loopback0
 ip address 10.0.34.3 255.255.255.0
!
router ospf 100
 ! Define area 9 as a totally stubby area
 area 9 stub no-summary
 ! Virtual link from area 9 to area 0
 area 2 virtual-link 10.0.34.2
```